



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ³ : A63F 9/08; A63H 33/00	A1	(11) International Publication Number: WO 83/ 01203 (43) International Publication Date: 14 April 1983 (14.04.83)
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(21) International Application Number: PCT/US81/01654
(22) International Filing Date: 14 December 1981 (14.12.81)
(31) Priority Application Number: 309,751
(32) Priority Date: 8 October 1981 (08.10.81)
(33) Priority Country: US

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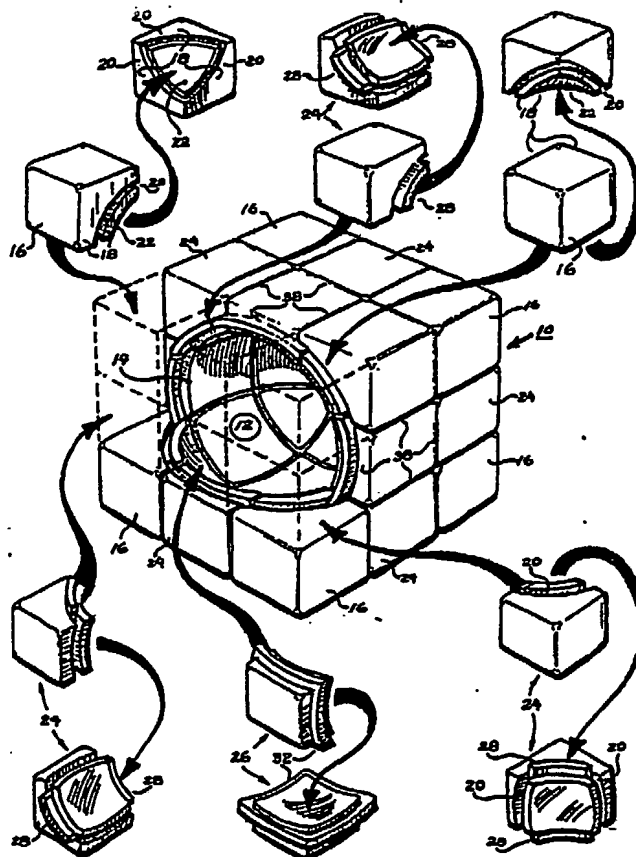
(81) Designated States: AT (European patent), AU, BR, CH
(European patent), DE (European patent), DK, FI,
FR (European patent), GB (European patent), HU,
JP, KP, LU (European patent), NL (European pa-
tent), NO, SE (European patent).

Published
With international search report.

(54) Title: THREE-DIMENSIONAL GEOMETRIC PUZZLE

(57) Abstract

Puzzle related to the famous 'Rubik's Cube' wherein instead of defining a plain cube, a sculptured surface is created defining a head (Fig. 6), a globe (Fig. 7), or any other shape wherein the shape itself is determinative of the correct positioning of the individual cube elements rather than merely utilizing colors of the faces of a cube to determine correct ordering. Additionally, a new operative structure is provided in the disclosed puzzle which utilizes no internal spider connector as does the Rubik's Cube, but rather each element interconnects with adjacent elements with a tongue-and-groove structure (23 and 20, 30 and 32) that positively detains all of the elements along an imaginary spherical surface.



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Description

Three-Dimensional Geometric Puzzle

Background of the Invention

At the time of this writing, the "Rubik's Cube" is famous, well publicized, and is fascinating millions of people. The Rubik's Cube is a large cube, each face of which is defined by nine elements together defining the cube exterior. These elements fall in three types according to how they are retained together. Basically, however, the elements together define an interior spherical void and each element has an expanded interior nib which engages the portions of the sphere defined by surrounding elements. Of course, the elements would all fly apart if it were not for some positive retaining means of some of the elements, which is provided in the Rubik's Cube by a central six-legged spider which extends both directions along all three geometric axes and into which the center cublet of each facet is screwed.

The Rubik's Cube is indeed a fascinating puzzle. Each facet of the cube rotates around the center element, so that by rotating different facets, different cubelets are moved from one facet to the next until complete chaos in cubelet arrangement is obtained. Reorganizing the cube into its original form, that form being with each facet of the cube being a uniform color and different from the



colors of each of the other facets, is a feat that would take the ordinary person many days to accomplish because of the fact that no single cubelet can be moved individually (without taking the cube apart) so that movement of any one cubelet into its proper position will disorient other cubes which have been positioned.

Ingenious as the Rubik's Cube is, there are at least two areas in which improvements could be made. First, the Rubik's Cube, by its very nature, must require considerable hand labor for assembly. Each facet must be rotated to screw the center piece into the retaining spider once all the pieces have been assembled together, which must require some time in itself. Secondly, although the cube with different colored facets is a good idea, the cube itself is somewhat limited, especially as an educational tool.

Summary of the Invention

The instant invention expands the basic concept of the Rubik's Cube and actually changes the entire internal structure and utilizes a new and different retaining mechanism which should make the cube easier, faster and cheaper to assemble with fewer parts and less material.

The spider retainer structure inside the sphere of the old

Rubik's Cube is eliminated entirely, with the cube elements being designed such that they will positively retain themselves in position with no inside structure. In addition, the flat faces of the cube have been replaced by fanciful designs of cartoon characters, clowns or
5 shrunken heads, football heroes, movie and TV stars, celebrities, globes, and the earth, moon, or planets, satellites, advertising designs for advertising premiums, prizes and awards, initials, funny animals, fish, fruits, football, basketball, TV, pair of shoes, slogans, hearts, games, funny car or airplane toys, spaceships, piano or organ, stack
10 of books, house, and other sculptured three-dimensionally contoured objects which yield not only more interest to the use of the cube but also, especially in the globe configuration, adds an educational dimension in the fields of medical, math and science to the puzzle not found in the prior art, as well as developing one's artistic skill
15 in recognizing forms that fit together.

Brief Description of the Drawings

Figure 1 is a partially exploded perspective illustrating the positioning of the three different types of cube elements in a square puzzle, with the exploded cube elements duplicated and rotated for
20 ease of understanding the structure;



Figures 2a, 2b, and 2c illustrate the corner element from the three sides which show the inner cube surface;

Figures 2d through 2g illustrate the edge cube element wherein a Figure 2d is nominally denominated as a top view, 2e is an elevation view from the right side, 2f is an elevation view from the left side, and 2g is an illustration from the front;

Figure 2h illustrates a typical side edge of the center cube element as it appears from any side;

Figure 2i illustrates a an apple;

Figure 2j illustrates a piggy bank version having a shear plane passing through the deposit slot;

Figure 2k illustrates an external configuration simulating a cottage;

Figure 2l illustrates a two-piece cube element construction;

Figure 2n illustrates an over-the-center detent structure optionally usable between adjacent cubelets;

Figure 2o is an external configuration of a funny car;

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PROCESSING
(See Administrative Instructions
Section 309(c) (ii))



of all the cubes being spaced slightly outwardly from the void 12.

The general concept of the puzzle is to permit each element to slide anywhere along the surface of the sphere 14 that is permitted by adjoining elements, with the elements or cubelets together defining
5 certain shear planes along which groups of elements will slide as described below.

The three different cubelet types are shown in Figure 1 and further detail in Figure 2. The corner cubelet 16 defines all of the corners of the cube and as seen in Figure 1 the portions of the corner
10 cube which are intersected by the spherical surface 14 create three side edges 18. According to the means of retaining the cubelets together of the instant invention, each of the three edges 18 of the corner cube is provided with a curved slot or groove 20 which
15 2a through 2c, the portion of the void 12 defined by the corner cubelets is shown in the curved surface 22.

The second type of cubelet, shown in Figure 1 and Figures 2b through 2g, is the edge cubelet 24 which falls between a pair of corner cubelets 16 and a pair of center cubelets 26. The edge
20 cubelets each have a pair of opposed tongues 28 engaged in the slots



or grooves 20 of the corner cubelets, and on opposite faces have a pair of grooves 30 which mate with the tongues 32 of the center cubelets 26. The center cubelets have tongues 32 on all sides.

Because of the nature of the parts, they are all in the same pattern relative to the other cubelets on each facet of the main cube. That is, although the corner cubes and the edge cube may be changed by rotating one facet, the corner cubes are always in the corner and the edge cube is always on an edge. This makes it possible to interlock them with this simple tongue-and-groove arrangement.

Obviously, the tongues could be reversed with the grooves to achieve the same result. This is an equivalent construction. Additionally, there may be other tongue-and-groove patterns that would equally well hold the parts together.

However, there is also needed a positive detent so that the cubelets will not simply expand radially and fall apart. This problem was solved in the original cube (i.e., Rubik's Cube, which did not use a tongue-and-groove) by the use of an internal spider. However, the instant puzzle utilizes a detent structure such as that shown in Figure 2m wherein a bead 34 falls within a groove 36 which would ordinarily be used on each of the tongue-and-groove combinations. This structure



has been omitted from the other drawings to simplify the illustration and not because it would not be included although a model with a bead only around the center faceted cubes would hold the unit together. Also, the bead-and-groove could be reversed from the configuration in Figure 2m, provided there was a consistency. By the use of the bead-and-groove and the tongue-and-groove construction, assembly of the unit is enormously simplified over the Rubik's Cube. Rather than having to screw the center facets into a retaining spider, the cubelets can simply be positioned and snapped into place by external pressure. No central structure and no retaining structure is needed. Additional advantageous structure is shown in Figure 2n wherein a molded detent rib 37 and mating cavity 39 cause the cubelets to snap into position with a positive over-the-center motion when they align.

The operation is not determined by the external cubical shape of the puzzle but rather by the shear faces. These shear faces are indicated in Figure 1 at 38 and in the illustrations comprise two spaced planes and each of the X, Y, and Z axes. As long as these planes are used, the external surface of the puzzle can take any desired shape. Additionally, there are many more surfaces which



could be chosen as shear planes, for example, radial planes which intersect the center of the spherical surface 14. However, regardless of the shear plane configuration utilized any exterior shape can be used provided it conforms to the shear planes. If this criterion is met, the surface could theoretically extend infinitely far and the puzzle would still function properly.

It should also be noted that in order to make the cubelets or elements translation in three dimensions the basic central sphere 14 must be used. However, conceivably an oblate spheroid or other modification of a spherical surface could be used provided the tongue-and-groove structure was sufficiently loose, or possibly resilient, to bend somewhat as the curvature changes from one portion of the surface to another.

Varying configurations are shown in Figures 2h through 2k and 2/o. These figures illustrate the variety of different external surface arrangement are possible, including the apple or skull of Figure 2i, and the piggy bank of Figure 2j wherein the deposit slot is intersected by a shear plane such that coins can only be inserted, or possibly extracted, when the slot halves are properly aligned.

Figure 2k illustrates a cottage, and 2o is a funny car.



Certain other representative shapes are shown in Figures 3 through 7, Figure 3 illustrating a satellite 40, which could be visually divided into three separate color zones, such as red, white and blue. Figure 5 illustrates a unit wherein a sphere 42 is inscribed with letters so that a message is spelled when the elements are properly arranged. Instead of letters, X's and O's of a Tic-Tac-Toe could be inscribed, or numbers, which could be arranged to get the maximum sum on a single face. Figure 6 illustrates a helmeted head of a football player which could bear the colors and logos of a particular team for promotional purposes, and Figure 7 illustrates a world globe which would be ideal for instructional and educational purposes. The globe of Figure 7 could also be in the shape of the moon, or the other planets. Provided one knew basically how to reassemble the cube into its proper configuration, repetitive reassembly of the unit of Figure 7 clearly would instruct the user rapidly in the positions of the various countries, seas, and other geographical features of the world, as knowledge of these would be a requirement to proper assembly of the puzzle elements.

It would also be possible and desirable to construct an interior basic configuration to which various outer surface configurations could

be readily attached. Along similar lines, Figure 21 illustrates a two-piece element, with a lower piece 44 which falls generally within the spherical surface 14 and an upper piece 46 which both defines the exterior surface of the puzzle and the groove structure so that the bead groove 36 may be easily incorporated into the upper portion of the unit as it comes off of an injection mold.

As mentioned, beyond this, a construction whereby a basic sphere with means of attaching an arbitrary set of external surface elements would be quite useful, and would possibly enable an extremely cheap unit to be made which could be easily adapted for commercial and even giveaway purposes by combining the universal fit working mechanism with an inexpensive set of exterior defining elements to promote a business or service, or different games, different heroes or stars.

It would also be possible to take these basic concepts and utilize the central spider structure of the Rubik's Cube. It is the configuration of the external surface of the puzzle into sculptured shapes which is believed to be a large part of the novelty in addition to the unique new retaining structure. By the incorporation of a sculptured exterior into the puzzle, especially the globe, an entire



new dimension of use is introduced into the basic concept. Whereas formerly the unit must by nature be merely a puzzle, the unit of the instant invention can be used, as indicated, as a commercial message bearing unit, or as an educational tool.

5 While I have described the preferred embodiment of the invention, other embodiments may be devised and different uses may be achieved without departing from the spirit and scope of the appended claims.

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CLAIMS

1. A three-dimensional geometric puzzle comprising:
 - (a) a plurality of elements;
 - (b) means holding said elements together as an aggregate assembly;
 - 5 (c) each of said elements having means cooperating with all adjacent elements permitting the sliding of said elements relative to adjacent elements along an imaginary spherical surface;
 - (d) said elements being shaped to define a plurality of aggregate shear planes in said assembly to permit mutual movement of a group
10 of elements on respective opposite sides of said shear planes; and
 - (e) said elements shaped such that the external surface of the assembly defines an identifiable three-dimensional object when said elements are properly arranged such that a user may practice randomizing and subsequently re-ordering said elements for amusement
15 and educational purposes.
2. Structure according to Claim 1 wherein said object is a world globe.
- 20 3. Structure according to Claim 1 wherein said object is a replica of a head.



4. Structure according to Claim 1 wherein said object is a replica of a bank, said puzzle contains an internal void, and including a slotted coin deposit imprint into said void and intersecting one of said shear planes such that alternative alignment or misalignment of portions of said slot on opposite sides of said at least one shear plane will alternatively permit or prohibit access to said void through said slot.

5. A three-dimensional geometric puzzle comprising:

(a) a plurality of individual elements grouped together in an aggregate assembly such that each element is intersected by an imaginary spherical surface;

(b) each of said elements defining with each adjacent element an element pair, and each element pair defining a tongue-and-groove interengagement structure substantially along said spherical surface;

(c) said elements together defining a plurality of shear planes intersecting said spherical surface such that groups of elements bordering on said shear planes will traverse therealong, along said tongue and groove structure; and



(d) said elements defining an identifiable external configuration when arrayed in one arrangement such that a user can randomize and subsequently re-order said elements into said one arrangement.

5 6. Structure according to Claim 5 wherein said tongue-and-groove structure includes positive detent means active transversely of the tongue-and-groove structure to resist separation thereof.

10 7. Structure according to Claim 6 wherein said detent means comprises a cooperating bead-and-groove defined in said tongue-and-groove structure.

15 8. Structure according to Claim 7 wherein each of said elements is formed by two pieces mated together substantially along the plane of said spherical surface to facilitate production of said tongue-and-groove structure with said bead-and-groove defined therein.

9. Structure according to Claim 5 wherein said elements fall into three engagement types as follows:

20 (a) a corner type having three grooved engaging edges;



(b) an edge type having two tongued edges and two grooved edges; and

(c) a center type having four tongued edges.

5 10. Structure according to Claim 9 and including detent structure locking the respective tongues in the respective grooves of said tongue-and-groove structure to permit motion only longitudinally of the interfaces defined thereby in a sliding manner.

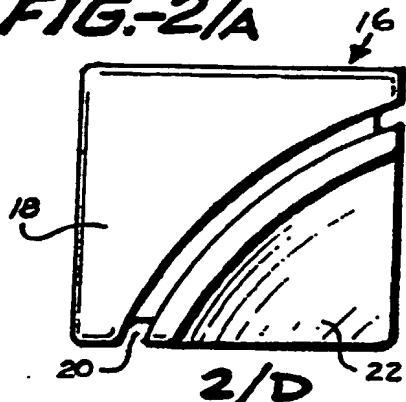
10 11. Structure according to Claim 9 wherein all tongued-and-grooved edges recited therein are switched with tongued edges being grooved edges and grooved edges being tongued edges.

15 12. Structure according to Claim 5 wherein at least some of said element pairs include cooperative over-the-center detents to effect proper alignment of the elements.

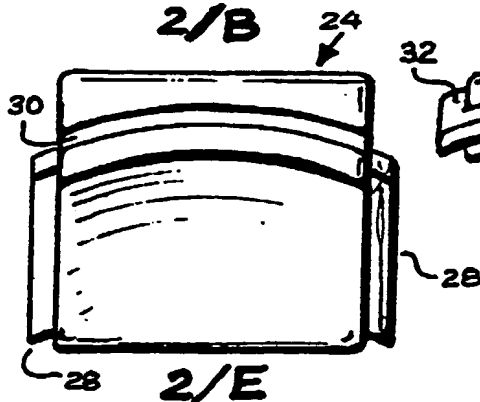
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2/3

FIG-2/A



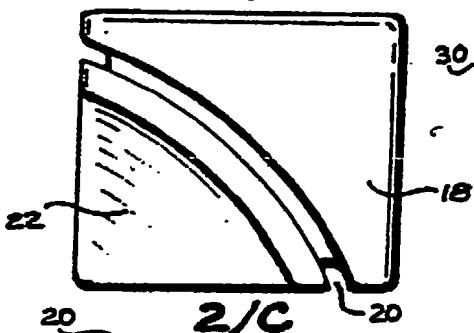
2/B



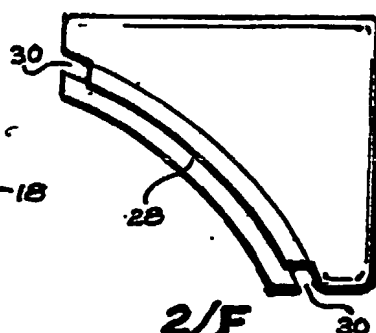
2/H 2/3



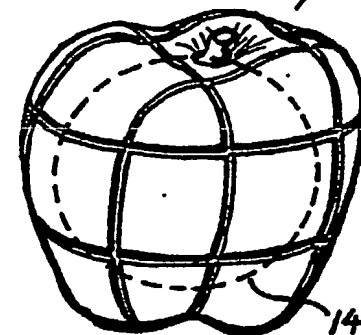
2/D



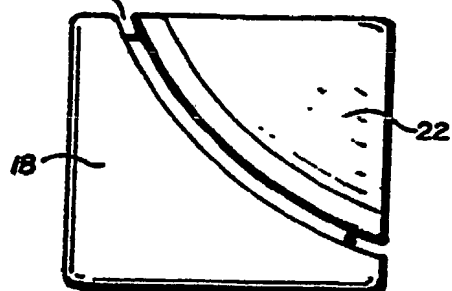
2/E



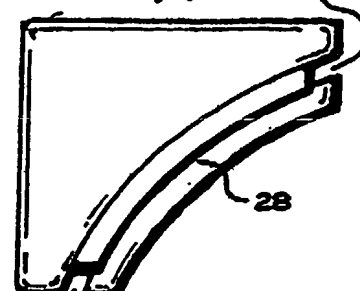
2/I



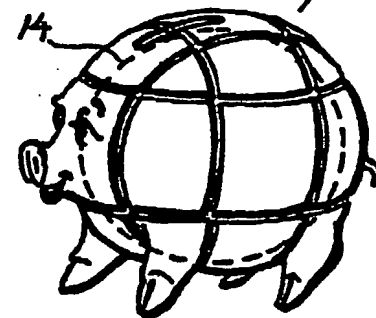
2/C



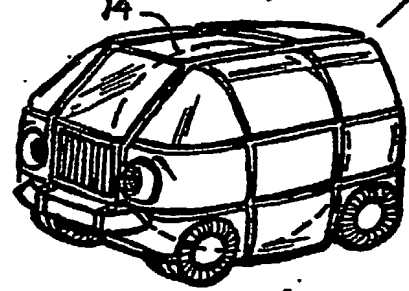
2/F



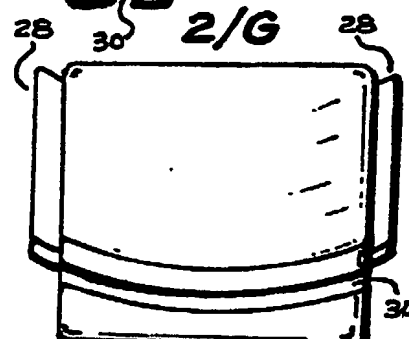
2/J



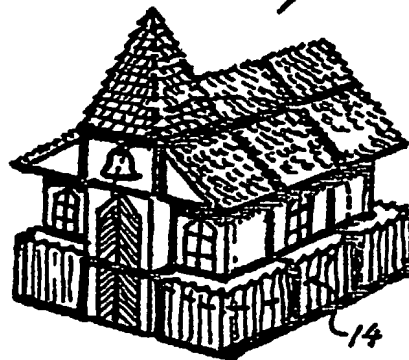
2/O



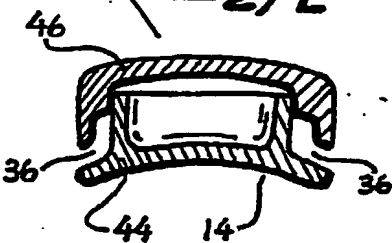
2/G



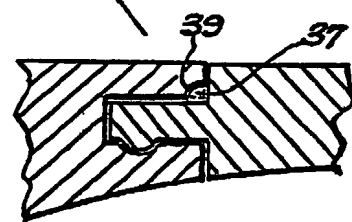
2/K



2/L



2/M



SUBSTITUTE SHEET

BUREAU
OMPI
WIPO

FIG.-3

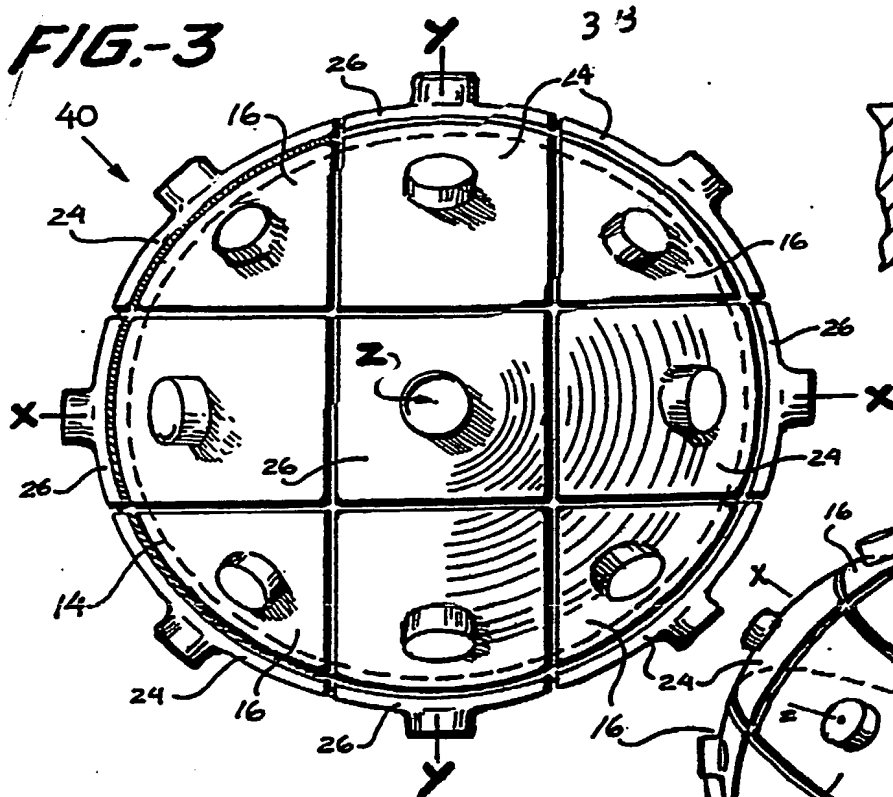


FIG.-8

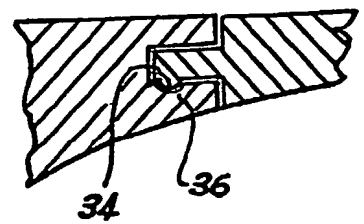


FIG.-4

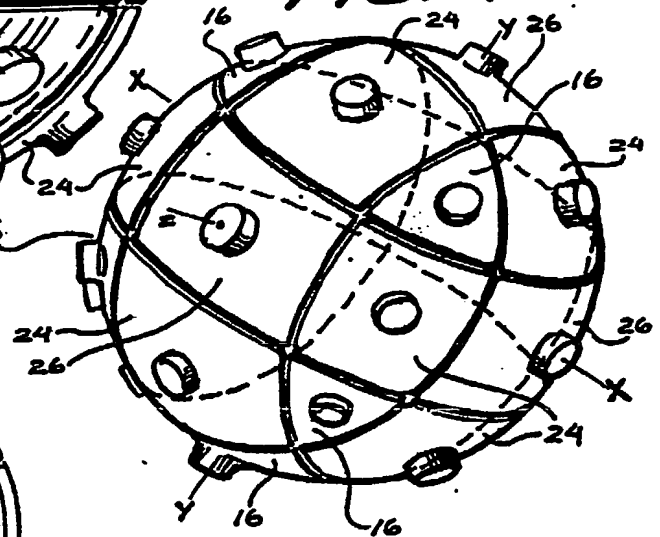


FIG.-5

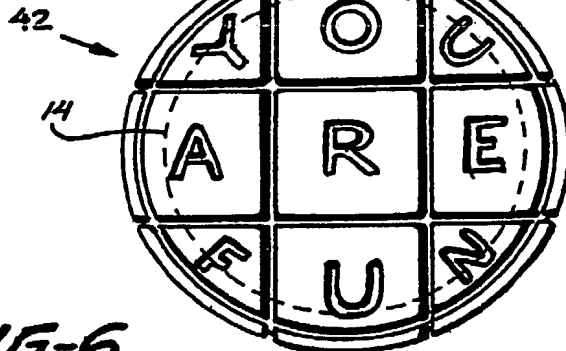


FIG.-6

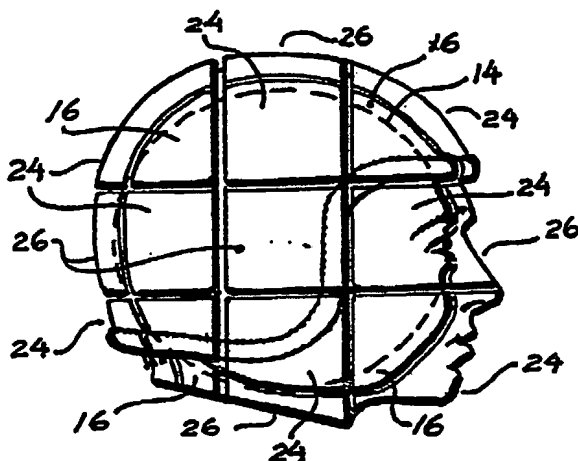


FIG.-7



SUBSTITUTE SHEET



INTERNATIONAL SEARCH REPORT

I. CLASSIFICATION OF SUBJECT MATTER (If several classifications apply, indicate all)
 According to International Patent Classification (IPC) or to both National Classification and IPC
 International Application No. PCT/US81/01654

INT. CL. 3 A63F 9/08; A63H 33/00
 U.S. CL. 273/153S; 46/2

II. FIELDS SEARCHED

Classification System

Minimum Documentation Searched⁴

Classification Symbols

US

273/153S, 155,160
 46/2, 25,30
 206/1,5

Documentation Searched other than Minimum Documentation
 to the extent that such Documents are included in the Fields Searched⁴

III. DOCUMENTS CONSIDERED TO BE RELEVANT¹⁴

Category *

Citation of Document, ¹⁰ with indication, where appropriate, of the relevant passages ¹⁷

Relevant to Claim No. ¹⁸

X	HU, A, 170,062, Published 31 December 1977, See pg. 10, lines 9-11 and 13-16 of translation	1-4
X	JP, B, 55-3956, Published 28 January 1980	1,5-12
X	JP, B, 55-8193, Published 03 March 1980, See Fig. 6, pg. 2 lines 1-3 and pg. 4, lines 19-22 of translation	1-3
X	US, A, 2,987,318, Published 06 June 1961, See Fig. 4	3
X	US, A, 3,921,312, Published 25 November 1975	6,7,8,10,11
X	US, A, 3, 650,379, Published 21 March 1972	4
X	US, A, 2,712,447, Published 05 July 1955	2-12
X	N, Evercheering Enterprise Co., Ltd. brochure, no date of publication, recorded 19 June 1981, see No. 10	2

* Special categories of cited documents: ¹⁵

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"T" later document published on or after the international filing date and not in conflict with the application, but cited to understand the principle or theory underlying the invention

"X" document of particular relevance

IV. CERTIFICATION

Date of the Actual Completion of the International Search :

17 February 1982

International Searching Authority :

ISO/US

Date of Mailing of this International Search Report :

11 MAR 1982

Signature of Authorized Officer ²⁰

Anton O. Oechsle
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